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to create a general confidence, and interest in it; the risk of further trials is now freely incurred, and its extensive adoption is highly probable.

The simple process of natural absorption, by immersing the foot of a newly-felled tree in a preservative solution, say the pyroligneous of iron, seems well deserving of consideration and further experiment. By this process it would appear that the vitality remaining in the wood, for a short time after it has been cut, causes the artificial fluid to circulate with the natural sap throughout the whole tree. Mr. Bethell claims a right in this process of patent dated July 11th, 1888. Public attention was drawn to the discovery by Dr. Bouchard, of Paris, in 1840. It would, of course, be necessary that this process should be practiced on the spot where the timber is cut.

It seems difficult to stanch too much importance in these provinces to some feasible and certain method of rendering wood, if not imperishable, at least capable of resisting decay for a long period. The effect would be to place us in a position to prosecute a railway system, and other works, at a cost moderate as to removal of waste, and the cost of the process. It would probably, also, give us a large share of additional manufacturing benefit in the staple of the country. For the preservative process seems to be most easy and effective when applied whilst the wood is in a green state.

WOOD AS A SUBSTITUTE FOR IRON RAILS. So far we have chiefly considered the eligibility of wood as the principal material in railway foundations. A further substitution of wood for iron rails, and thereby rendering nearly the whole expense of the latter, has perhaps engaged more attention in these provinces than in the United States. On first naming the subject of wooden rails in that country, you are understood to be the subject of a great deal of ridicule, and the subject is generally abandoned in favour of the heavy iron rail. The light iron plate of 24 inches by 1 inch is found to be too flexible, and the wood beneath it too compressible. It is now found that the wooden rail, of longitudinal sill, upon which a light plate of iron is laid and secured, as in the first experiments there. But this expedient having been found to be very objectionable and inefficient, especially under the action of the heavy iron wheels, is generally becoming abandoned in favour of the heavy iron rail. The light iron plate of 24 inches by 1 inch is found to be too flexible, and the wood beneath it too compressible.

It may be alleged that the statements of the experiments as yet made, though calculated to give a favorable impression, do not conclusively settle the question of the safe application of the wooden rail to the various circumstances of a long line of railway intended to sustain heavy loads and subjected to great velocities, has been made known to draw attention in these colonies to the importance of a more perfect investigation of the subject. A few suggestions in relation to it I will venture to submit.

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To remedy this the breadth of the surface of the rail was increased, which diminished the evil to a certain extent, but the expense of repairs was still considerable. A complete remedy was eventually effected by the use of a different form of the rim of the wheels in the process of casting. The further improvement of introducing malleable iron rails, was for several years retarded by the same evil which first appeared in the use of the cast iron rail, the narrowness of the edge being found to cut the periphery of the wheels. The cast iron rail with a broader surface was therefore preferred, because a malleable iron rail with a surface sufficiently broad to support the weight of a malleable iron rail was produced, the section of which presented the same bearing surface as the cast iron, combining with lightness the necessary degree of strength. (Wood's Treatise on Railroads, pp. 8, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

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Now it seems manifest that these progressive improvements proceeded from a necessary regard to the relative hardness of the periphery of the wheel and the bearing surface of the rail. Cast iron wheels were found to cut a soft material like wood, and rendered also cast iron rails apparently necessary. But these, when narrow, were found in return to cut the wheels, an evil which was in part remedied by making the surface of the rail broader, and more perfectly remedied by making the periphery of the wheel harder. It was also found necessary to the success of the malleable iron rail that its breadth of bearing surface should be adjusted to the relative hardness of the periphery of the wheel.

These considerations seem applicable to the failure of the iron plate rail spoken upon a rail of wood, as tried in the United States. It is obvious that a thin plate of iron, only two and a half inches wide, could do no more than protect the wood from the abrasive action of the wheels. It was too narrow and flexible to prevent the effects of compression. Hence nearly the same result might be expected, though in a less rapid and sensible degree, from the first experiments of narrow cast iron wheels running immediately upon wood. A thin strip of iron, subjected to the rolling action of a heavy pressure, and depending for its stiffness upon soft and irregularly shaped wood, would not be able to sustain the essential qualities of a rail. It could not remain either uniformly flat or rigid.

For this evil there appear to be three remedies, differing materially in their relative economy. 1. An iron plate rail widened to an extent to be determined by its increased stiffness, and the hardness of the wheel. 2. An iron rail of suitable form, and sufficiently stiff to compensate for its narrowness of bearing upon wood. 3. A rail exclusively of wood, to which the width of the rim of the wheels of the locomotive and of the train shall be duly adjusted.

The second of these remedies is that adopted in the United States, and which involves a minimum of expense of eight or nine thousand dollars per mile of the iron and its fastenings. Yet without further and satisfactory experiments there seems to be no sufficient reason to doubt that nearly the whole of this outlay might be avoided by the third proposed remedy; and which is the adoption of a duly proportioned wooden rail, to be acted upon by iron wheels, the periphery of which shall be plain, and of a width which shall be adjusted to the weights and velocities to be sustained and the relative hardness of the wood, thereby obviating the necessity of a bearing surface of metal in any form. But the experiment shall include the substitution for the "flanges" now in use, either the grooved diagonal guide wheels of Mr. Fitch, or plain horizontal wheels to roll against the inner side of the rail, for the same purpose.

I would therefore suggest, in order more perfectly to test the merits of this kind of rail, that such experiments should be made as may be sufficient to determine whether its efficiency does not depend upon a due adjustment of the width of the rim of the wheels, a may be due to the relative hardness of the wood under the pressure of given loads, and under the least favourable circumstances incident to railway transportation. It is probable that the result of such experiments would be to show that the diminution of the compression is

not nearly as the square of the ratio of the increase of the width of the periphery of the wheel, that is to say, by increasing width three, three, or four times, we relieve the fibres of the rail from the compressing or crushing effect four, nine, or sixteen times.

Further experiments appear also to be necessary in order to determine the adhesion of the driving wheel upon wood under various circumstances. It has been represented as much more than upon iron. In a dry state this is very probable; but in a perfectly wet state it